

11/02/00
J0945 U.S. PRO

11-03-00

A

PATENT APPLICATION
Docket No.: 45051-00004
P 1874-108US BA/AF

11/02/00
97401/60
S. N. 222
P.T.O.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re patent application of: Mats OLSSON and Zhinong YING

For: AN ANTENNA DEVICE, AND A PORTABLE TELECOMMUNICATION APPARATUS INCLUDING
SUCH AN ANTENNA DEVICE

BOX PATENT APPLICATION
Commissioner of Patents
Washington, D.C. 20231

CERTIFICATE OF MAILING BY EXPRESS MAIL

"EXPRESS MAIL" Mailing Label No. EL524961960US

Date of Deposit: November 2, 2000
I hereby certify that the paper(s) and/or fee(s) listed
below are attached hereto and are being deposited with the
U.S. Postal Service "Express Mail Post Office to Addressee"
service under 39 CFR 1.10 on the date indicated above and is
addressed to the Commissioner of Patents, Washington, D.C.
20231

Type or Print Name: Dorothy MacKinnon

Dorothy MacKinnon
Signature

Sir:

PATENT APPLICATION TRANSMITTAL LETTER

Transmitted herewith for filing, please find the following:

1. (XX) The specification of the above-referenced patent application is
enclosed herewith (13 pages including claim(s) and Abstract).
2. (XX) 6 sheet(s) of:
 informal drawing(s) is (are) enclosed herewith.
X formal drawing(s) is (are) enclosed herewith.

3. (X) The fees for this application have been calculated and included as shown below (Prior to calculating the fees, please enter any enclosed preliminary amendment.):

	NO. FILED	NO. EXTRA	RATE	FEE
BASIC FEE				\$710.00
TOTAL CLAIMS	19 -20	0	\$18	0
INDEPENDENT CLAIMS	1 - 3	0	\$80	0
MULTIPLE DEPENDENT CLAIM(S) PRESENTED			\$270	270.00
TOTAL FEES:				\$980.00
Deduct One-Half for Small Entity Status				
Assignment Recordal Fee			\$40	40.00
TOTAL AMOUNT DUE:				\$1020.00

4. X Checks in the amount of \$980.00 and 40.00 are enclosed herewith. Please charge any deficiency or credit any overpayment to Deposit Account No. 10-0447.

— Please charge my Deposit Account No. _____ in the amount of \$ _____. Please charge any deficiency or credit any overpayment to Deposit Account No. _____.

5. (X) An oath or declaration is enclosed herewith that is:

— Unsigned

X Newly executed per 37 CFR 1.63(a) and (b).

— A copy of the executed declaration filed in the prior application upon which priority is based, showing the signature or an indication thereon that it was signed; and:

— This application is being filed fewer than all of the inventors named in the prior application and it is requested that the following name or names be deleted from the list of inventors in the prior application for this continuation or divisional application:

— The prior application was accorded status under 37 CFR § 1.47 and is accompanied by:

— A copy of the decision granting a petition to accord Sec. 1.47 status to the prior application (unless all of the inventors have or legal

representatives have filed an oath or declaration to join in the prior application).

A copy of the subsequently executed oath(s) or declaration(s) filed by the inventor(s) or legal representative(s) that have subsequently joined in the prior application.

6. (X) The power of attorney for this application:

X is appointed in the newly executed Oath or Declaration submitted herewith.
is appointed by the power of attorney enclosed herewith.
remains the same as originally in the parent application.
was changed during the prosecution of the parent application and a copy of the change in the power of attorney is enclosed herewith.

7. (XX) The correspondence address for this application shall be:

Stanley R. Moore, Esq.
Jenkins and Gilchrist, P.C.
3200 Fountain Place
1445 Ross Ave.
Dallas, Texas 75202

X which is a new correspondence address or a change therein.
which is the same as originally in the parent application.
which is the change in the correspondence address that was filed during the prosecution of the parent application.

8. (X) Priority is hereby claimed under 35 USC 119 and 172 to the following foreign applications:

Country	Serial No.	Date
<u>Sweden</u>	<u>9904002-4</u>	<u>03 Nov 1999</u>
_____	_____	_____
_____	_____	_____

and:

A certified copy of each application is enclosed herewith.
A certified copy of each application was filed in prior application Serial No. _____.

9. () A verified statement claiming small entity status under 37 CFR 1.9 and 1.27:

is enclosed herewith.
was filed in parent application Serial No. _____, and such status remains unchanged and is requested for this application.

10. () A preliminary amendment is enclosed herewith.

11. () An Information Disclosure Statement with Modified PTO Form 1449 and a copy of the cited references are enclosed herewith.

12. (X) An Assignment of the invention to TELEFONAKTIEBOLAGET L M ERICSSON (publ) with cover sheet and recordation fee is enclosed herewith for recordation by the Assignment Branch.

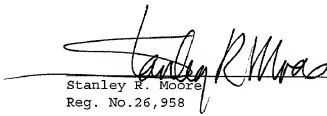
13. (XX) The Commissioner is hereby authorized to charge payment, or to credit any overpayment, of the following fees associated with this filing or during the pendency of this application to Deposit Account No. 10-0447.

X Any patent application filing fees under 37 CFR 1.16.
X Any patent application processing fees under 37 CFR 1.17.
— The issue fee under 37 CFR 1.18 at or before mailing of the Notice of Allowance, pursuant to 37 CFR 1.311(b).

14. () Other (specify): _____

15. (XX) Confirmation Postcard.

Respectfully submitted,


Stanley R. Moore
Reg. No. 26,958

Jenkins & Gilchrist, P.C.
3200 Fountain Place
1445 Ross Avenue
Dallas, Texas 75202-2799
214/855-4713
214/855-4300 (Fax)

EL524961960US

**AN ANTENNA DEVICE, AND A PORTABLE TELECOMMUNICATION
APPARATUS INCLUDING SUCH AN ANTENNA DEVICE**

5 **Technical Field**

 The present invention relates to the field of radio
communication and, in more particular, to an antenna device
for use in a portable telecommunication apparatus of the
type having a first antenna adapted for telecommunication
10 in at least a first frequency band and a second antenna
adapted for short-range supplementary communication in a
second frequency band.

Prior Art

15 Examples of a portable communication apparatus as
set out above are a mobile telephone, a cordless telephone,
a portable digital assistant, a communicator, a paging
device, an electronic payment device, or a portable navi-
gating device. Among these, the mobile or cellular tele-
20 phone is currently believed to be the most prominent in
terms of market penetration and sales volumes. Therefore,
for the rest of this document, reference will be made to
a mobile or cellular telephone for any commercially avail-
able mobile communications network, such as GSM, UMTS or
25 D-AMPS. However, the invention is not limited to merely a
mobile telephone. On the contrary, the invention is best
defined by the appended independent patent claims.

 Traditionally, older mobile telephones were only
capable of normal speech communication between two users
30 through a mobile communications network and, in many situa-
tions, a public switched telephone network. Historically,
mobile telephones have often been provided with a monopole
antenna mounted externally to the apparatus housing of the
telephone. Rod antennas, whip antennas and helix antennas
35 are some examples of such external monopole antennas.

More recently, some mobile telephones have been provided with built-in antennas in the form of a printed pattern of conductive material. Microstrip patch antennas, meandering monopole antennas and planar inverted F-type antennas (PIFA) are examples of such antennas.

Even more recently, short-range supplementary communication services have been introduced for mobile telephones. One example of such a short-range supplementary communication service is commonly referred to as Bluetooth® and operates within an unlicensed frequency band at 2.4 GHz, which is often referred to as ISM ("Instrumental, Scientific and Medical") and is globally available. Bluetooth® is intended to provide flexible communication of data and speech between portable devices, such as mobile telephones, laptop computers, personal digital assistants (PDA), and various peripherals for these devices, such as printers, wireless headset accessories, etc.

Conventionally, the antenna for short-range supplementary communication (hereinafter referred to as "Bluetooth® antenna") is implemented as a separate unit, which is located on the secondary side of the main printed circuit board inside the mobile telephone, well separated from the cellular antenna. However, as mobile telephones get smaller and smaller in size, the available printed circuit board area also decreases. Cellular radio circuitry must be prioritized in the layout of the printed circuit board, and as a result, in existing telephones, the Bluetooth® antenna has been placed in areas on the keyboard side of the printed circuit board, where the performance in talking position is not good.

Moreover, if the Bluetooth® antenna is positioned too close to the cellular antenna on the printed circuit board, separate filtering components must be provided in order to isolate the cellular antenna from the Bluetooth® antenna so as to avoid interference.

Summary of the Invention

The present invention seeks to remedy the problems set out above. In particular, it is an object of the invention to provide an antenna device for a miniaturized mobile telephone, which allows excellent performance both for a multi-band cellular antenna and a short-range supplementary communication antenna (e.g. Bluetooth®). Additionally, the desired solution is one where interference between the two antennas is avoided without a major cost penalty, and which allows low costs for development and production of antenna components.

The above objects have been achieved by an antenna device, where the cellular antenna is combined with the Bluetooth® antenna by placing the two antennas together on a common support element, such as a flexible dielectric film. Preferably, the two antennas are implemented as traces of printed conductive material. The different traces, i.e. the cellular antenna trace and the Bluetooth® antenna trace, have separated feeding and grounding points. The support element is preferably mounted in a plastic or rubber antenna housing, which is assembled in the rear cover of the telephone. The two antenna traces are preferably connected to the printed circuit board (and the cellular and Bluetooth® radio circuitry thereon) by an antenna connector having resilient contact pins for each feeding/grounding point.

In a preferred embodiment of the invention the cellular antenna trace is a triple-band printed monopole type antenna having only a single feeding point. The Bluetooth® antenna is a PIFA-type antenna having a feeding point and a grounding point.

By placing the Bluetooth® antenna in the top area of the back cover of the mobile telephone, the antenna performance gets better. Low component and development costs

are available thanks to the invention. The proposed antenna device has a small size and can be encapsulated in a thin flexible rubber or plastic housing, allowing high flexibility for the designer of the mobile telephone.

These and other objects, features and advantages of the present invention will appear clearly from the following detailed disclosure of a preferred embodiment, from the enclosed drawings as well as from the appended claims.

It should be emphasized that the term "comprises/ comprising" when used in this specification is taken to specify the presence of stated features, integers, steps or components but does not preclude the presence or addition of one or more other features, integers, steps, components or groups thereof.

Brief Description of the Drawings

A presently preferred embodiment of the present invention will be described in the following detailed disclosure, reference being made to the accompanying drawings, in which

FIG 1 is a schematic front view of a portable telecommunication apparatus with an antenna device according to the preferred embodiment, as well as an example of an environment in which it may operate,

FIG 2 is a schematic block diagram of the main components of the portable telecommunication apparatus shown in FIG 1,

FIG 3 is a detailed perspective rear view of the portable telecommunication apparatus in FIGs 1 and 2, illustrating primarily the antenna device,

FIG 4 is a perspective rear view corresponding to the one in FIG 3, but where the antenna device is shown integrated with the portable telecommunication apparatus,

FIGs 5a-c show a front view, side view and perspective view, respectively, of the first and second antennas

(the cellular antenna and the short-range supplementary communication antenna) of the antenna device, provided on a common support element,

FIGs 6a-c show a front, side and perspective view, respectively, of an antenna connector for connecting the antenna device to the portable telecommunication apparatus, and

FIGs 7a-c show a front, side and perspective view, respectively, of the antenna device shown in FIGs 5a-c when connected to a printed circuit board in the portable telecommunication apparatus through the antenna connector shown in FIGs 6a-c

Detailed Disclosure

FIGs 1-3 illustrate a mobile telephone 1 as a schematic front view, a block diagram and a detailed perspective rear view, respectively. As seen in the drawings, the mobile telephone 1 has an antenna device 10, which is mounted to an upper rear portion of the mobile telephone 1, immediately above a battery 44. The antenna device 10 has a cellular antenna 21, which is electrically connected to a cellular radio transceiver 23 on a printed circuit board 33 (FIG 3) through an antenna connector 28, as will be described in more detail later.

Thus, the mobile telephone 1 may establish a wireless link 16 to a radio station (base station) 17 in a mobile telecommunications network 18, such as GSM, UMTS or D-AMPS.

The antenna device 10 moreover comprises a short-range supplementary communication antenna 22, which is referred to as the "Bluetooth® antenna" in the rest of this section. The Bluetooth® antenna 22 is electrically connected to Bluetooth® radio circuitry on the printed circuit board 33 through the antenna connector 28. In a manner generally known per se the mobile telephone 1 may establish another wireless link 19 to a peripheral device 20 through

the Bluetooth® antenna 22. The peripheral device 20 is illustrated as a printer in FIG 1 but may equally well be another mobile telephone, a laptop computer, a stationary computer, a personal digital assistant (PDA), a modem, a telefax machine, a wireless headset accessory, a home appliance, etc.

As seen in FIG 1, the mobile telephone 1 comprises a number of conventional components, such as a loudspeaker 11, a display 12, a set of cursor keys 13, an alphanumeric keypad 14 and a microphone 15. These components are not believed to require any detailed description herein.

Before turning to the remaining figures, which will illustrate the antenna device 10 in more detail, reference is made to FIG 2, which illustrates the above on a general level. As seen in FIG 2, the mobile telephone 1 comprises a main controller 25, which preferably is mounted on the printed circuit board 33. The main controller 25 may be implemented by any commercially available microprocessor or another type of programmable logic circuitry. The main controller 25 is operatively connected to the cellular radio 23 and the Bluetooth® radio 24.

Referring now to FIGs 3-7c, the antenna device 10 will be described in detail. The antenna device 10 comprises a support element 26, 27, upon which both the cellular antenna 21 and the Bluetooth® antenna 22 are mounted. In the preferred embodiment, the common support element 26, 27 is a flexible dielectric film. Suitable film materials are commercially available from Rogers Corporation, Circuit Materials Division, 100 N. Dobson Road, Chandler, AZ-85224, USA, or alternatively from Freudenberg, Mectec GmbH & KG, Headquarters, D-69465 Weinheim/Bergstrasse, Germany. Such flexible dielectric films are utterly thin; the typical thickness ranges from about 70 µm to about 400 µm.

As shown in FIG 3, the flexible dielectric film has a first portion 26, on which the cellular antenna trace 21

is printed. The flexible dielectric film also has a second portion 27, on which the Bluetooth® antenna trace 22 is printed. As shown in FIG 5b, the two portions 26 and 27 may be arranged at a certain angle to each other. It is to be observed that the antenna traces 21 and 22 are provided on the "rear surface" of the flexible dielectric film 26, 27 as viewed in FIG 3, i.e. the surface that faces the rear side of the mobile telephone 1. Therefore, the antenna traces 21 and 22 are only indicated by dashed lines in FIG 3. The shapes of the cellular antenna trace 21 and the Bluetooth® trace 22 appear more clearly from FIG 5a, FIG 5c, FIG 7a and FIG 7c

Referring back to FIG 3, the flexible dielectric film 26, 27 is provided in an antenna housing 42 preferably made of plastic or rubber. The antenna housing 42 has a form that fits a corresponding recess in the upper rear portion of the cover of the mobile telephone 1, immediately above the battery 44.

The cellular antenna 21 is tuned to the or each frequency band that it is intended to operate in. In the preferred embodiment the cellular antenna 21 is tuned for operation in the 900 MHz GSM band and also at least one of the 1800 MHz DCS band and the 1900 MHz PCS band, preferably both of these. However, other antenna band constellations, both their number and their respective nominal frequency, are applicable to the invention. Additionally, the layout of the cellular antenna 21 may be different than the one illustrated. The exact layout of the cellular antenna 21 is to be determined by a skilled person as a matter of routine design work, due care being taken to the intended application.

The cellular antenna trace 21 forms a monopole-type antenna and has a single feeding point 41 but is not electrically grounded. The Bluetooth® antenna 22, on the other hand, has a feeding point 39 as well as a grounding point

40, which is positioned in proximity with the feeding point 39. The Bluetooth® antenna 22 is a planar inverted F-type antenna (PIFA) adapted to operate within the 2.4 GHz ISM band according to the preferred embodiment. The feeding point 41 of the cellular antenna trace 21 is electrically isolated from the feeding point 39 and grounding point 40 of the Bluetooth® antenna trace 22.

The cellular antenna trace 21 and the Bluetooth® antenna trace 22 are connected to the respective radio circuitry on the printed circuit board 33 through the antenna connector 28. More specifically, as appears particularly from FIGs 6a-c, the antenna connector 28 has a first contact pin 31, which provides electrical contact between the feeding point 41 of the cellular antenna trace 21 and a first contact point 36 on the printed circuit board 33. In turn, the cellular radio 23 is electrically connected to the contact point 36. Moreover, the antenna connector 28 has a second contact pin 29 for connecting the feeding point 39 of the Bluetooth® trace 22 and a second contact point 34 on the printed circuit board 33, said second contact point 34 being electrically connected to the Bluetooth® radio 24. Additionally, the antenna connector 28 has a third contact pin 30, the purpose of which is to connect the grounding point 40 of the Bluetooth® antenna trace 22 with a grounding point 35 on the printed circuit board 33.

In the preferred embodiment, the contact pins 29, 30 and 31 of the antenna connector 28 are implemented as resilient pogo pins. Alternatively, the contact pins may advantageously be implemented as spring ledges, or as another type of contact members, including fixed (non-resilient) means.

The antenna connector 28 also has an external antenna connector 32 for allowing an external antenna, such as a vehicle-mounted handsfree antenna, to be coupled to an

external antenna input 37 on the printed circuit board 33 through an opening in the flexible dielectric film 26, 27 and a corresponding opening 43 in the antenna housing 42.

As seen in FIGs 7a and 7c, the printed circuit
5 board 33 has fastening openings 45 and 46 for allowing safe mounting of the printed circuit board 33 within the cover of the mobile telephone 1.

The present invention has been described above with reference to a preferred embodiment. However, other em-
10 bodiments than the one referred to above are equally possible within the scope of invention, which is best defined by the appended independent claims.

CLAIMS

1. An antenna device (10) having a first antenna (21) adapted for telecommunication in at least a first frequency band and a second antenna (22) adapted for short-range supplementary communication in a second frequency band, characterized in that

the first and second antennas (21, 22) are formed on a common support element (26, 27).

10

2. An antenna device as in claim 1, where the first and second antennas (21, 22) are formed as printed traces of conductive material on said support element (26, 27).

15

3. An antenna device as in claim 1 or 2, where said support element comprises a flexible dielectric film.

20

4. An antenna device as in claim 2 or 3, where the first antenna (21) comprises a first feeding point (41) and the second antenna (22) comprises a second feeding point (39), the first and second feeding points being electrically isolated from each other.

25

5. An antenna device as in claim 4, where the second antenna (22) comprises a grounding point (40) positioned in proximity with the second feeding point (39).

30

6. An antenna device as in claim 5, where the second antenna (22) is a planar inverted F-type antenna (PIFA).

7. An antenna device as in any of claims claim 4-6, where the first antenna (21) is a monopole antenna.

35

8. An antenna device as in claim 6, where the second antenna (22) is adapted for Bluetooth® communication in a 2.4 GHz frequency band.

9. An antenna device as in claim 7, where the first antenna (21) is a multi-band antenna.

5 10. An antenna device as in claim 9, where the first antenna (21) is adapted for communication in a 900 MHz frequency band and at least one of an 1800 MHz frequency band and a 1900 MHz frequency band.

10 11. A portable telecommunication apparatus (1), characterized by an antenna device as defined in any of claims 1-10.

15 12. A portable telecommunication apparatus as in claim 11, further comprising a printed circuit board (33) with radio circuitry (23, 24) mounted thereon, and an antenna connector (28) adapted to provide electric contact between the first and second antennas (21, 22) and said radio circuitry (23, 24).

20 13. A portable telecommunication apparatus as in claim 12, the antenna device being defined by claim 5, wherein the antenna connector (28) has:

25 a first resilient contact pin (31) adapted to engage with the first feeding point (41) of the first antenna (21),

a second resilient contact pin (29) adapted to engage with the second feeding point (39) of the second antenna (22), and

30 a third resilient contact pin (30) adapted to engage with the grounding point (40) of the second antenna (22).

35 14. A portable telecommunication apparatus as in claim 13, wherein the first, second and third resilient contact pins (31, 29, 30) are pogo pins.

15. A portable telecommunication apparatus as in claim 13, wherein the first, second and third resilient contact pins (31, 29, 30) are spring ledges.

5

16. A portable telecommunication apparatus as in any of claims 11-15, where the antenna device (10) is contained in a plastic or rubber antenna housing (42), which is attached to an upper rear portion of the portable telecommunication apparatus.

10

17. A portable telecommunication apparatus as in any of claims 11-16, where the apparatus is a radio telephone (1), preferably a mobile telephone.

15

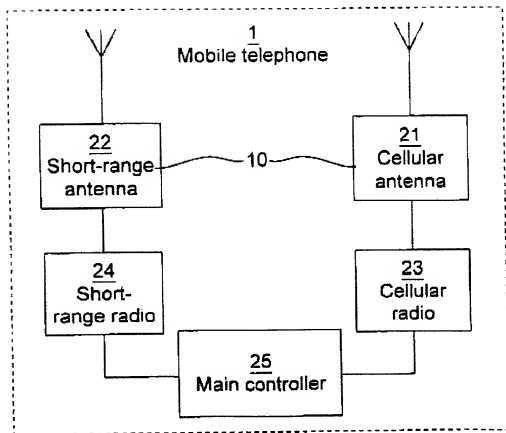
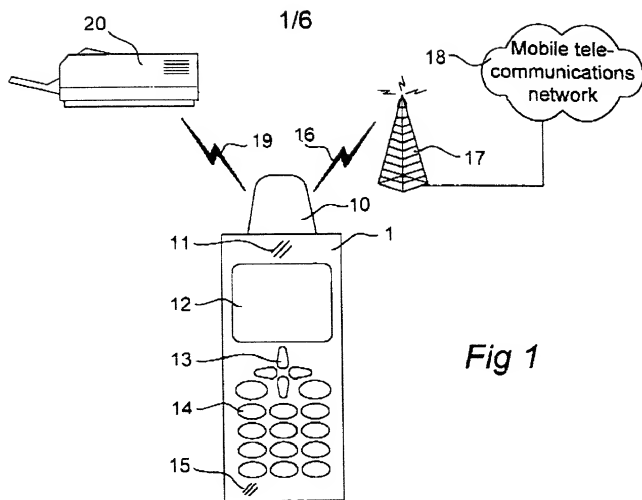
18. A portable telecommunication apparatus as in claim 17, where the apparatus is adapted for use in a GSM, UMTS or D-AMPS mobile telecommunications network.

ABSTRACT

An antenna device (10) for a portable telecommuni-
cation apparatus (1) has a first antenna (21) adapted for
5 telecommunication in at least a first frequency band and a
second antenna (22) adapted for short-range supplementary
communication in a second frequency band. The first and
second antennas (21, 22) are formed on a common support
element (26, 27).

10

To be published together with FIG 3.



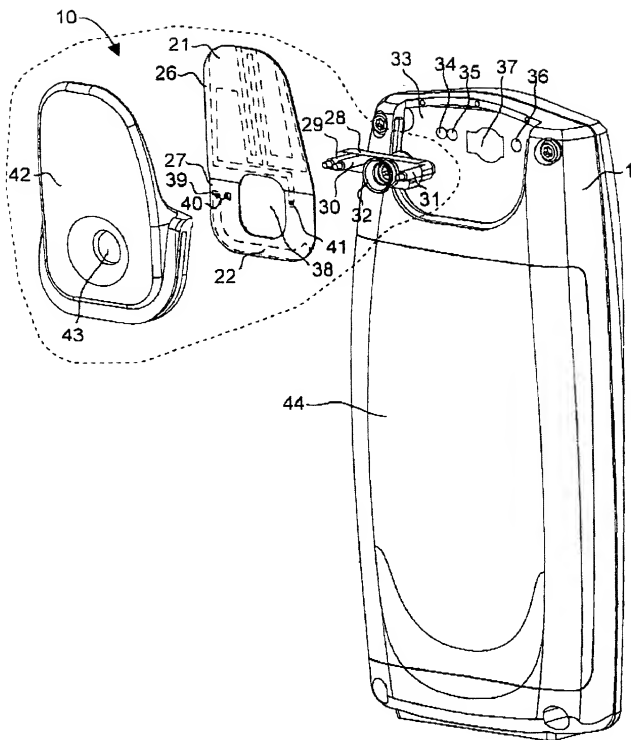


Fig 3

3/6

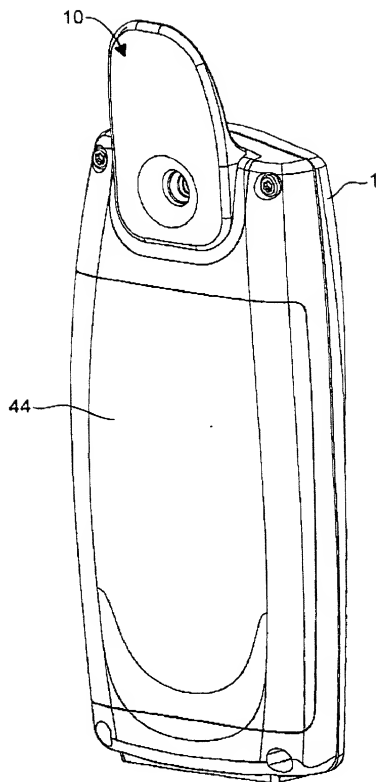


Fig 4

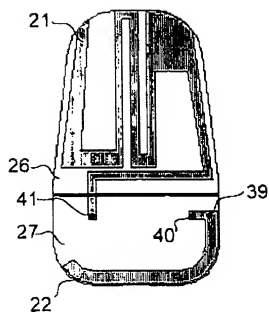


Fig 5a

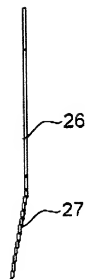


Fig 5b

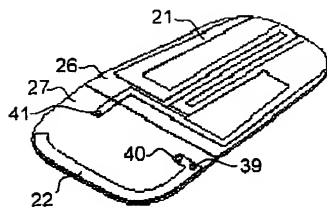


Fig 5c

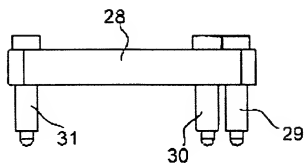


Fig 6a

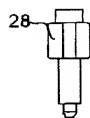


Fig 6b

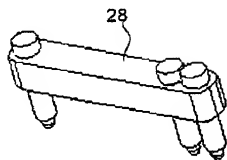


Fig 6c

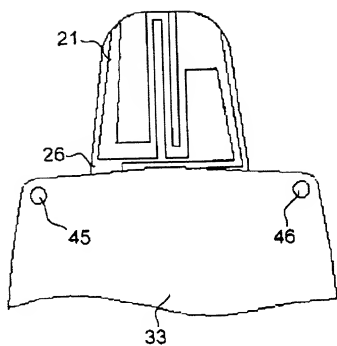


Fig 7a

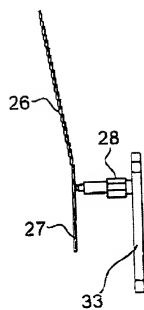


Fig 7b

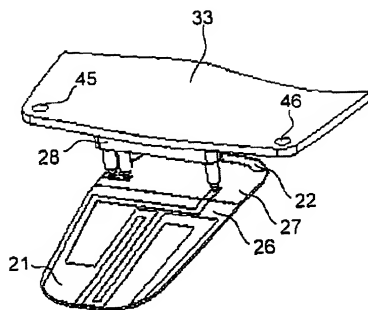


Fig 7c

**RULES 63 AND 67 (37 C.F.R. 1.63 and .67)
DECLARATION AND POWER OF ATTORNEY**

FOR UTILITY/DESIGN/CIP/PCT NATIONAL APPLICATIONS

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name; and

I believe that I am the original, first and sole inventor (if only one name listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Multiband Antenna Arrangement

the specification of which: (mark only one)

- ☒ (a) is attached hereto.
☐ (b) was filed on _____, 199__ as Application Serial No. _____ and
was amended on _____ (if applicable)
☐ (c) was filed as PCT International Application No. PCT/ _____ on _____
and was amended on _____ (if applicable).
☐ (d) was filed on _____ as Application Serial No. _____ and was issued
a Notice of Allowance on _____.
☐ (e) was filed on _____ and bearing attorney docket number _____.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims as amended by any amendment referred to above or as allowed as indicated above.

I acknowledge the duty to disclose all information known to me to be material to the patentability of this application as defined in 37 CFR § 1.56. If this is a continuation-in-part (CIP) application, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose to the Office all information known to me to be material to patentability of the application as defined in 37 CFR § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this CIP application.

I hereby claim foreign priority benefits under 35 U.S.C. § 119/365 of any foreign application(s) for patent or inventor's certificate listed below and also identified below any foreign application for patent or inventor's certificate filed by me or my assignee disclosing the subject matter claimed in this application and having a filing date (1) before that of the

PRIOR FOREIGN PATENTS

Number	Country	Month/Day/Year Filed	Date first laid- open or Published	Date patented or Granted	Priority Claimed	
					Yes	No
9904002.4	SE	11/03/1999				

I hereby claim the benefit under 35 U.S.C. § 120/365 of any United States application(s) listed below and PCT international applications listed above or below:

PRIOR U.S. OR PCT APPLICATIONS

Application No. (series code/serial no.)	Month/Day/Year Filed	Status (pending, abandoned, patented)

I hereby appoint:

TIMOTHY G. ACKERMANN Reg. No. 44,493
 THOMAS E. ANDERSON Reg. No. 37,063
 BENJAMIN J. BAI Reg. No. 43,481
 MICHAEL L. BLANKSTEN Reg. No. 37,097
 MARY JO BOLDINGKY Reg. No. 34,713
 MARGARET A. BOULWARE Reg. No. 28,709
 ARTHUR J. BRADY Reg. No. 42,356
 MATTHEW O. GRADY Reg. No. 44,394
 THOMAS L. CANTRELL Reg. No. 20,649
 RONALD B. COOLLEY Reg. No. 27,147
 THOMAS L. CRISMAN Reg. No. 24,846
 STUART D. DWOICK Reg. No. 31,101
 WILLIAM F. ESSER Reg. No. 38,053
 ROGER J. FRENCH Reg. No. 27,786
 JANET M. GARETTO Reg. No. 42,568
 JOHN G. GATZ Reg. No. 41,774
 RUSSELL J. ODMET Reg. No. 42,571
 J. KEVIN GRAY Reg. No. 37,441
 STEVEN R. GRIENFIELD Reg. No. 38,166
 KEVIN R. HANSBRO Reg. No. 38,483
 J. PAT HEPTIE Reg. No. 40,643
 SHARON A. ISRAEL Reg. No. 41,867
 JOHN L. KIRK, JR. Reg. No. 24,477

PAUL R. KITCH Reg. No. 38,208
 TIMOTHY M. KOWALSKI Reg. No. 44,192
 HSIN-WEI LUANG Reg. No. 44,213
 JAMES F. LEA III Reg. No. 41,143
 ROBERT W. MASON Reg. No. 42,848
 ROGER L. MAXWELL Reg. No. 31,855
 ROBERT A. McFALL Reg. No. 28,968
 STEVEN T. McDONALD Reg. No. 45,999
 LISA H. MEYERHOFF Reg. No. 36,869
 STANLEY R. MOORE Reg. No. 26,094
 RICHARD J. MOURA Reg. No. 34,883
 MARK V. MULLER Reg. No. 37,509
 P. WESTON MUELSEMAN JR. Reg. No. 31,644
 DANIEL O. NGUYEN Reg. No. 42,933
 SPENCER C. PATTERSON Reg. No. 43,449
 RUSSEL K. RUPPANOONTI Reg. No. 39,521
 STEPHEN G. RUDISILL Reg. No. 20,087
 HOLLY L. RUDNICK Reg. No. 43,063
 J.L. JENNIE SALAZAR Reg. No. 45,065
 KEITH SAUNDERS Reg. No. 41,402
 JERRY R. SELINGER Reg. No. 26,392
 GARY B. SOLOMON Reg. No. 44,347
 WAYNE D. STACY Reg. No. 45,125

STEVE Z. SZCZEPANSKI Reg. No. 27,957
 ANDRE M. SZUWALSKI Reg. No. 35,701
 ALAN R. THELE Reg. No. 20,694
 TAMSEN VALOIR Reg. No. 41,417
 RAYMOND VAN DYKE Reg. No. 34,746
 BRIAN D. WALKER Reg. No. 37,551
 GERALD T. WELCH Reg. No. 20,337
 HAROLD N. WELLS Reg. No. 26,044
 WILLIAM D. WIESE Reg. No. 45,217

all of the firm of JENKENS & GILCHRIST, P.C., 3200 Fountain Place, 1445 Ross Avenue, Dallas, Texas 75202-2799, as my attorneys and/or agents, with full power of substitution and revocation, to prosecute this application, provisional thereof, continuations, continuations-in-part, divisionals, appeals, reissues, substitutions, and extensions thereof and to transact all business in the United States Patent and Trademark Office connected therewith, to appoint any individuals under an associate power of attorney and to file and prosecute any international authorities, and I hereby authorize them to act and rely on instructions from and communicate directly with the person/assignee/attorney/firm/ organization who/which first sent this case to them and by whom/which I hereby declare that I have consented after full disclosure to be represented unless/until I instruct them in writing to the contrary.

Please address all correspondence and direct all telephone calls to:

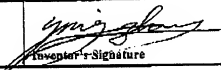
Gerald T. Welch
Jenkins & Gilchrist, P.C.
3200 Fountain Place
1445 Ross Avenue
Dallas, Texas 75202-2799
214/855-4713
214/855-4300 (fax)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so are made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

FIRST NAMED INVENTOR SIGNATURE: Mats Olsson

1	OLSSON, Mats	<i>Mats Olsson</i>	2000-10-09
	Full Name	Inventor's Signature	Date
	Malmö, Sweden	Swedish	
	Residence (city, state, country)	Citizenship	
	S. Gulsparvsgatan 27 B, SE-215 61		
	Post Office Address (include zip code)		

SECOND NAMED INVENTOR SIGNATURE: Zhinong Ying

2	YING, Zhinong		2000-10-10
	Full Name	Inventor's Signature	Date
	Lund, Sweden	Chinese	
	Residence (city, state, country)	Citizenship	
	Skyttelinjen 50, SE-226 49		
	Post Office Address (include zip code)		